PCT/GB 98/03797
20 JAN 1999

GB 98/03797

The Patent Office

09/582303

REC'D 08 FEB 1999
WIPO PCT

INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP9 1RH

5

PRIORITY DOCUMENT

SUBMITTED OR TRANSMITTED IN
COMPLIANCE WITH RULE 17.1(a) OR (b)

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

I also certify that by virtue of an assignment registered under the Patents Act 1977, the application is now proceeding in the name as substituted.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed AHBrewer.

Dated 13 January 1999

Patents Form 1/77

Patents Act 1977
(Rule 16)

The Patent Office

1/77

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

Confirmation Fax

The Patent Office
Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference — 1491 / 11

2. Patent application number *(The Patent Office will fill in this part)* — **9800883.2**

16JAN98 E331115-1 D02893
P01/7700 25.00 - 9800883.2

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Coralfoam Limited
Hill Hampton
East Meon
Petersfield
Hampshire GU32 1QN
United Kingdom

SECTION 30 ... 14.4.98

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation — United Kingdom 7207628001

4. Title of the invention

MOULDED ARTICLE

5. Name of your agent *(if you have one)* — NIGEL BROOKS CPA

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

HILL HAMPTON
EAST MEON
PETERSFIELD
HAMPSHIRE GU32 1QN

Patents ADP number *(if you know it)* — 463001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*
GB	na NA	NA NA

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

no

Patents Form 1/77

9. ..er the number of sheets for any of the follo... g items you are filing with this form. Do not count copies of the same document		
Continuation sheets of this form	0	
Description	~~5~~ 7	
Claim(s)	0	LP
Abstract	0	
Drawing(s)	~~4~~ 7	
10. If y... u are also filing any of the following, state how many against each item.		
Priority documents	0	
Translations of priority documents	0	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	0	
Request for preliminary examination and search *(Patents Form 9/77)*	0	
Request for substantive examination *(Patents Form 10/77)*	0	
Any other documents *(please specify)*		

11. I/We request the grant of a patent on the basis of this application.

Signature Date 23/12/97

12. Name and daytime telephone number of person to contact in the United Kingdom NIGEL BROOKS CPA (01730) 823647

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.

d) If you have answered 'Yes' Patents Form 7/77 will need to be filed.

e) Once you have filled in the form you must remember to sign and date it.

f) For details of the fee and ways to pay please contact the Patent Office.

The Patent Office

GB9800883.2

By virtue of a direction given under Section 30 of the Patents Act 1977, the application is proceeding in the name of

CORALTECH LIMITED
Hill Hampton
East Meon
PETERSFIELD
Hampshire
GU32 1QN
United Kingdom

Incorporated in the United Kingdom

[ADP No. 07209638001]

<u>Moulded Article</u>

The present invention relates to a method of forming an article via injection of plastics material into a mould.

In particular this invention is an improvement on the invention described in our patent application No 9727107.6 of 23rd December 1997 (" the Earlier Application"). That application reviewed the outlines of injection moulding, injection blow moulding and thermo-forming. In respect of the latter, it should here be noted that so called "plug-assist" thermoforming involves the use of a movable plug, which initial stretches the extruded sheet into cavities in the tooling prior to application of gas pressure to finally shape the material in the tooling.

The Earlier Application stated the basic invention to be a method of forming a plastics material article, consisting in the steps of:

forming an injection moulded preform between core and first cavity mould parts,

separating the first cavity mould part from the preform,

assembling a second, larger cavity mould around the preform and

blowing the preform away from the core part into a finished article shape.

It should be noted that whilst the above statement refers to the withdrawn and second, assembled moulded parts as "cavities", it is conceivable – though unlikely – that they could be convex.

The application continued with a review of the expected improvement in cycle time in comparison with the conventional injection/blow moulding process due to lack of indexing and reheating. It is anticipated that the cycle time will be of the order of 2.5 seconds, in comparison to a typical 5.0 seconds cycle for conventional injection blow moulding.

In the preferred embodiment of the earlier application, which is set out below for comparison with and better understanding of the present improvement, the preform is stretched to reduce its average wall thickness by a third. This ratio could

be between a quarter and a half, but is unlikely to be substantially greater reduction in wall thickness. An important advantage of the basic invention is that it enables the initial wall thickness to be selected such that when moulded and stretched, the finished wall thickness can be predetermined to suit the end use of the product. Thus in comparison with a deep drawn thermoformed container, where the base is likely to be of the same order of thickness as the extruded sheet from which it was formed and the side walls will be drawn as thin as practical, a situation which creates a large disparity between the base and the side wall thickness and in wasteful of material in the base, the basic invention allows a much more uniform wall thickness. Further this thickness can be thinner than that which is practically achievable by injection moulding.

In accordance with the present improvement, the preform is lifted from at least part of a fixed portion of the core part by a movable portion of the core part.

It can be appreciated that in the preferred embodiment of the basic invention this occurs to a negligible extent when the valve admitting pressurised gas is opened for blowing of the preform from the core, the end of the valve forming a portion of the core part.

In the improvement, the movable portion of the core part is moved to a substantial extent to stretch the moulded preform. The stretch will usually be in a selected region of the preform. Where the moulded article is a container with a base and a sidewall, the rim of the sidewall will usually remain attached to the fixed portion of the core and the base will be formed at the movable portion. The intervening sidewall will be stretched by forwards movement – downwards of the fininsh formed article – of the movable portion.

The forwards movement is likely to be accompanied by injection of low pressure gas into the container, to allow the sidewall to move off the fixed core portion without being held there by vacuum.

The attachment of the rim can be by polishing of the corresponding area of the fixed portion of the core. Alternatively or additionally, it can be captivated by the

petals, in which case the movable portion is not moved until the petals are in position. Otherwise the movable portion can be advanced before the petals are in position.

Similarly the periphery of the base can be attached to the movable portion, to limit the stretch in the base.

The movable portion can be moved forwards so far as to captivate the part of the preform on it between the movable portion and the corresponding portion of the petals. This has the advantage of enabling moulded features to be reproduced in the base – or equivalent part – of the article. For instance, the base may be formed in such a manner as to ensure that it stands stably without the centre being depressed. Further this can have particular advantage in the case of plant pots, whereby drainage apertures can be moulded in (obviously the preform could not be blown without some means of obturating the drainage apertures).

The application of full gas pressure for finally blowing the preform to shape against the petals can be timed to start before the stretching by the movable portion has been completed. This is unlikely to be the case were part of the preform is to be captivated as above. Further the blowing can be timed to start before the petals are fully closed into position. However, it will normally be started after the petals have been closed. Air or a purified gas can be used for blowing. It may be cooled to assist in cooling of the blown article.

A significant advantage of the invention is that it results in controlled bi-axial orientation of the article or at least its blown portion. The stretching involves axial strain and orients molecules of the plastics material in direction of stretching. The blowing, involving as it does radial expansion hence circumferential strain, strains the material orthogonally to the axial strain. Hence the bi-axial orientation.

It is anticipated that a greater degree of wall thickness reduction will be practical with this improvement than with the basic invention.

To help understanding of the invention, a specific embodiment thereof will now be described by way of example and with reference to the accompanying drawings, in which,

Figure 1 is a cross-sectional side view of a mould tool use in the basic invention, with a primary cavity closed;

Figure 2 is a similar view of the mould tool with a secondary cavity closed;

Figure 3 is an end view, from the right in Figure 2, of the closed petals forming the secondary cavity;

Figure 4 is a cross-sectional side view of the preform of Figure 1;

Figure 5 is a similar view of the end product of Figure 2;

Figure 6 is a diagrammatic view of a tool modified in accordance with the present improvement, with a preform injected;

Figure 7 is a similar view of the tool with the preform stretched by a movable portion of the core; and

Figure 8 is a similar view of the tool with the preform blown to finsh formed shape.

Referring to the drawings, the mould tool comprises a primary cavity 1, a core 2, a secondary cavity petals 3 and an actuation ring 4. The primary cavity 1 is attached to the fixed platen (not shown) of moulding machine in use and incorporates an injection gate 11, temperature control passages 12 and an ejection poppet valve 13.

The core 2 is attached to the moving platten (not shown), has temperature control passages 21, a blowing air valve 22 with its own temperature control passages 23 and four pivot points 24 for the secondary cavity petals 3, of which there are four.

The petals 3 have their own temperature control passages 31. They are generally L shaped and pivotally connected to the core at the elbow 32 of the L, which is rather more open than a conventional L. The feet 33 of the L chiefly comprise an "opening" surface 34, whilst the limbs of the L comprise a "closure" surface 35 on one side and a cavity surface 36 on the other side. They also comprise abutment surfaces 37 which mutually abut when the petals are closed to form the secondary cavity. Air bleeds 38 are provided.

The ring 4 carries four roller supports 41 having rollers 42 for co-operating with the opening and closure surfaces 34,35 and buffers 43,44. The ring is slidably supported on four bars 45.

In use, the ring 4 is withdrawn by a hydraulic ejection actuator (not shown) in the direction away from the primary cavity 1 and the core 2 is advanced into contact with the primary cavity, as shown in Figure 1. The preform 5 shape so defined is for a cup. It has a wall thickness 51 of 0.3mm except at the rim 52, which is thicker for foaming expansion. Within 0.2 sec. of the end of the injection of plastics material through the gate 11 to fill the mould gap between the core and the primary cavity, with a skin just formed against the cavity, the core 2 is withdrawn with application of air pressure to the poppet valve 13, whereby the moulded preform is withdrawn with the core.

As soon as the core is withdrawn sufficiently for mechanical clearance, the ring 4 is advanced. The rollers 42 leave the opening surfaces 34 and the forward buffers 43 knock the petals forward. The rollers then engage the closure surfaces 35 as the petals 3 swing closed about the pivots 24. The surfaces 35 have parallel ends 351, whereby when limit surfaces 45,39 on the roller supports and the petals engage, the petals are firmly held closed, see Figure 2. This position is reached within 0.5 sec. of core withdrawal, whereupon gas – suitably nitrogen at 40 bar – is blown through the valve 22 and the preform is expanded into the secondary cavity, to take up the shape 6 of the finished product. It should be noted that the petals have a groove 361 for allowing the rim 52 to expand. The typical wall thickness of the finished product is 0.2mm.

Immediately after blowing, the ring 4 is withdrawn, the rear buffers 44 knock the petals open and product falls from the tool. The latter can now close again for the next cycle. The total cycle time is expected to be 2 ½ seconds.

Temperature control is important – as always in injection moulding. It is to be expected that the primary cavity and the petals will be run cold, respectively to cause the preform to skin and allow early opening and to cause the blown product to become rigid for early opening of the petals. However, it is expected that the core will be run

warmer, so as to allow the preform to be in a state able to expand plastically when the gas is blown into the mould tool.

The basic invention is not restricted to the details of the above described embodiment. For instance the finished product as described is a circular cup. However, a rectangular container can be made by the method of the invention. For such, the four petals, shown in Figure 3 as meeting in a cross formation, may meet in a double/stem-to-stem Y formation, that is with two petals abutting at the stems of the Y's and two other petals having points filling the gaps in the heads of the Y's. Further more or less than four petals may be provided. Further for products having particularly vulnerable areas, such as corners, the wall thickness of the preform may be varied in areas stretching into the vulnerable areas, to reinforce them. This may involve thickening of adjacent areas to encourage stretching there, leaving the areas to be reinforced less stretched.

Referring now to Figures 5,6 & 7, the mould tool diagrammatically shown there comprises a primary cavity 101, a core 102, and a secondary cavity petals 103, which are essentially similar to the primary cavity 1, the core 2, and the secondary cavity petals 3. The exception is that the core is shaped as a truncated cone and comprised of a fixed portion 1021 and a movable portion 1022. At the proximal end of the core, the fixed portion has a narrow polished band 1023, whilst the balance of its length 1024 is matt finished as by bead blasting. The movable portion 1022 is of the same diameter as the distal end of the fixed portion and mates with it in the manner of a conical valve, whereby injected plastics material cannot enter between the portions, whereas the portions are readily separable by an actuator (not shown) for stretching of the preform 105 and egress of pressurised gas from within the core. The movable portion 1022 is relatively short in comparison with the fixed portion and is in the form of a disc with a matt radiused corner 1025 and a polished ring 1026 on its end face. Within the ring 1026, the movable disc has formations 1027 which together with formations 1017 in the cavity and formations 1037 in the ends 1033 of the petals form apertures 1061 and feet 1062 in a base 1063 of the finish formed article, which is a plant pot 106. It has sidewalls 1064.

On closure of the primary cavity 101 by the core 102 and injection of plastics material into it, the preform 105 is formed. The primary cavity 101 is withdrawn and the petals 103 are closed around the core and the preform. The movable ring 1022 is then advanced. In so doing, it axially stretches the preform between the polished banded 1023 and the polished ring 1026. At these polished areas, the plastics material is held onto the metal of the core, whereas it lifts from the metal at the intervening matt region 1024. In so doing a gap is opened between the plastics material and the core. This is filled with low pressure gas released as the movable disc is advanced, whereby the material is stretched without being influenced by unintentional stiction with the fixed portion 1021 of the core.

On completion of the forwards movement of the movable ring 1022, the plastics material within the polished ring 1026 is carried forwards into contact with the petals 103 and the features formed by the cavity formations 1027 are mated with corresponding petal formations 1037, whereby as the material fully cools the base 1063, with its apertures 1061 and feet 1062, sets off. As soon as the ring has reached this end of its stroke, higher pressure gas is released from the core, causing the stretched side wall 1064 to be expanded out circumferentially to the sides 1034 of the petals. At the radiused corner 1025 of the ring, the material rolls and is stretched into the corners 1035 of the petals.

It will be appreciated that although the improvement has been described with reference to a plant pot, it is applicable to a wide variety of finish formed products. In particular, the sidewalls of the petals can be contoured to provide contoured sidewalls to the finish formed product.

1/47

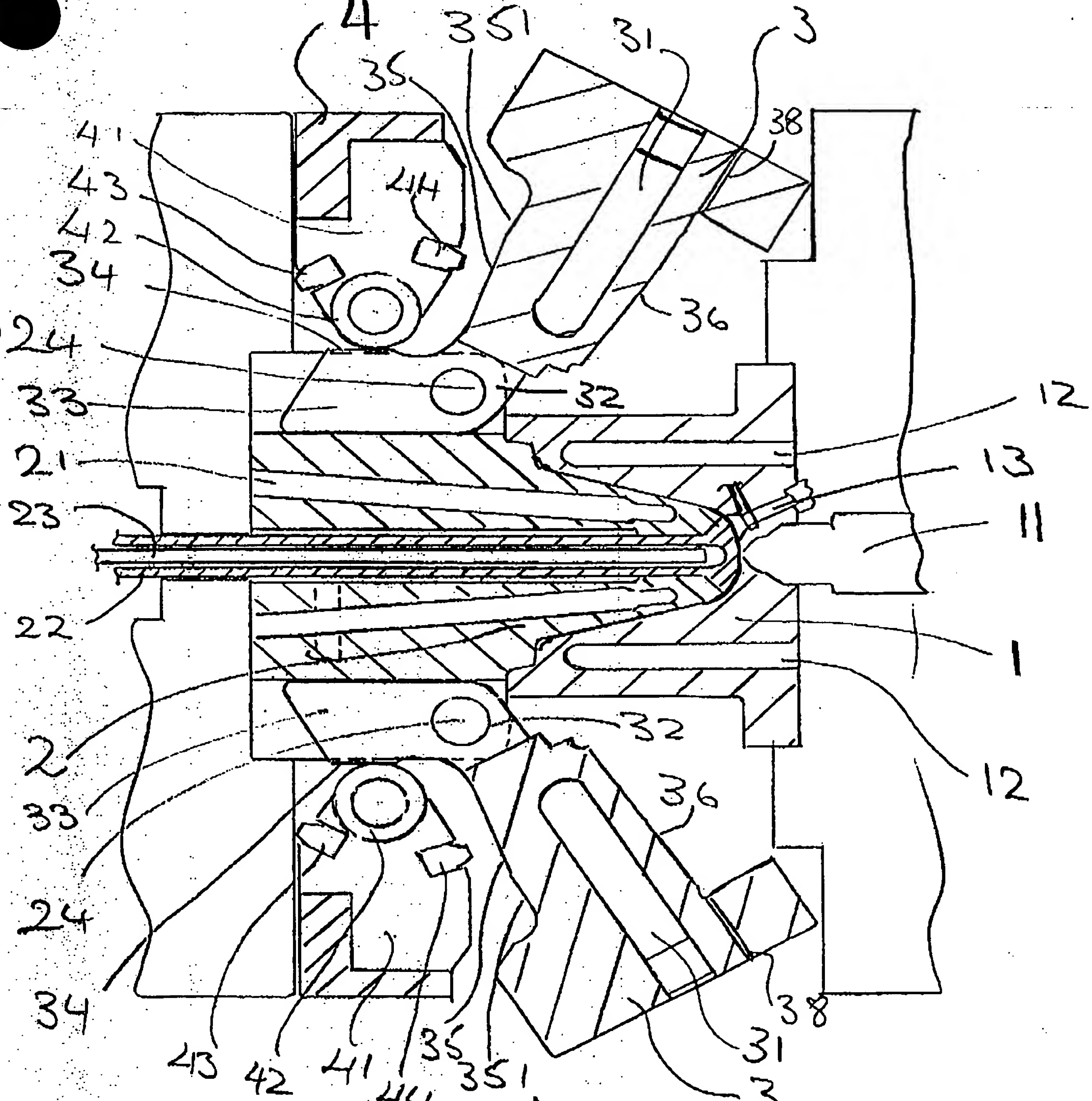
4
351
31
3
35
38
41
43
44
42
34
36
24
32
33
12
21
13
23
11
22
1
32
2
12
33
36
24
38
34
31
43
42
41
35
351
44
3

FIGURE 1

2/17

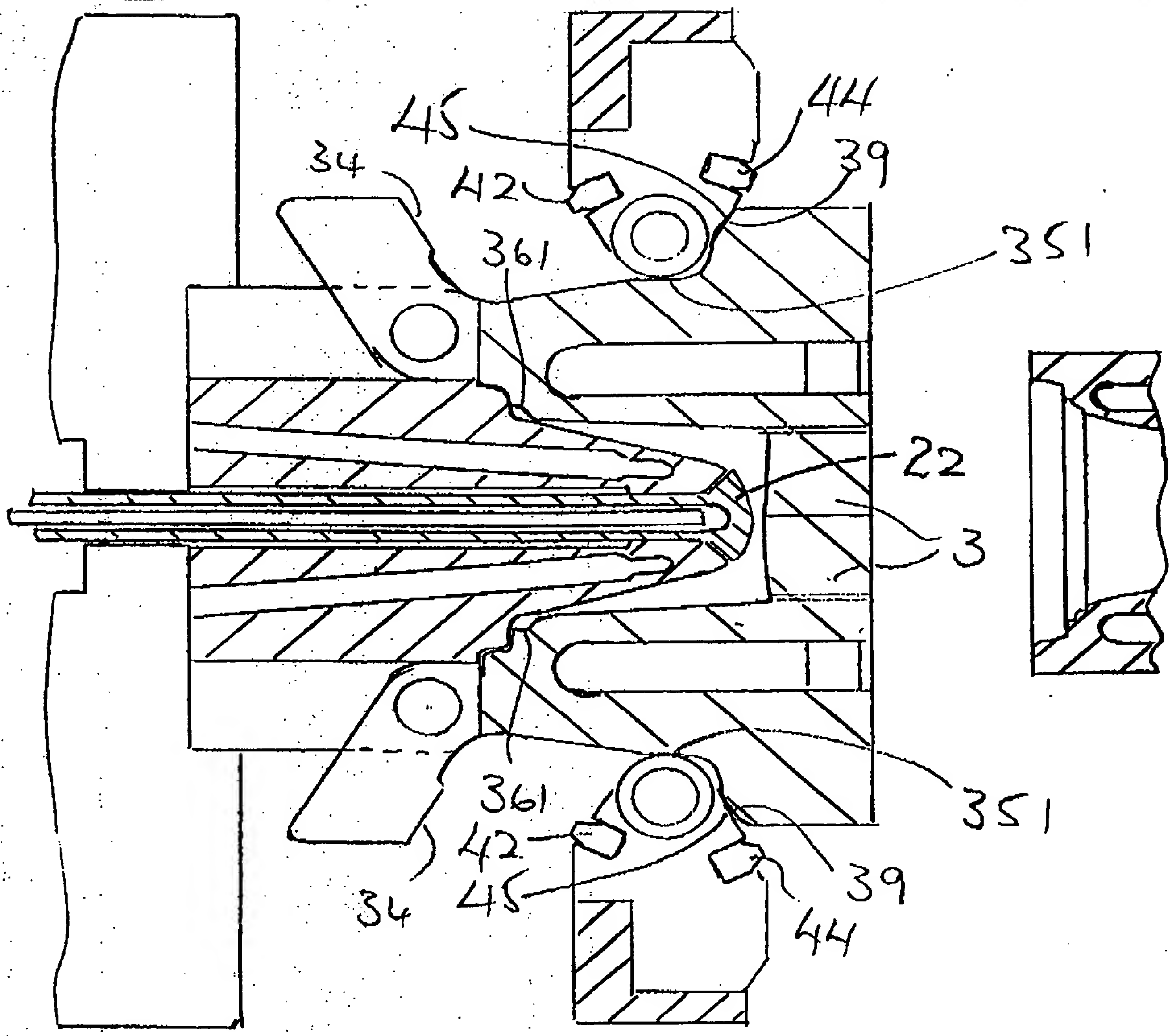

FIGURE 2

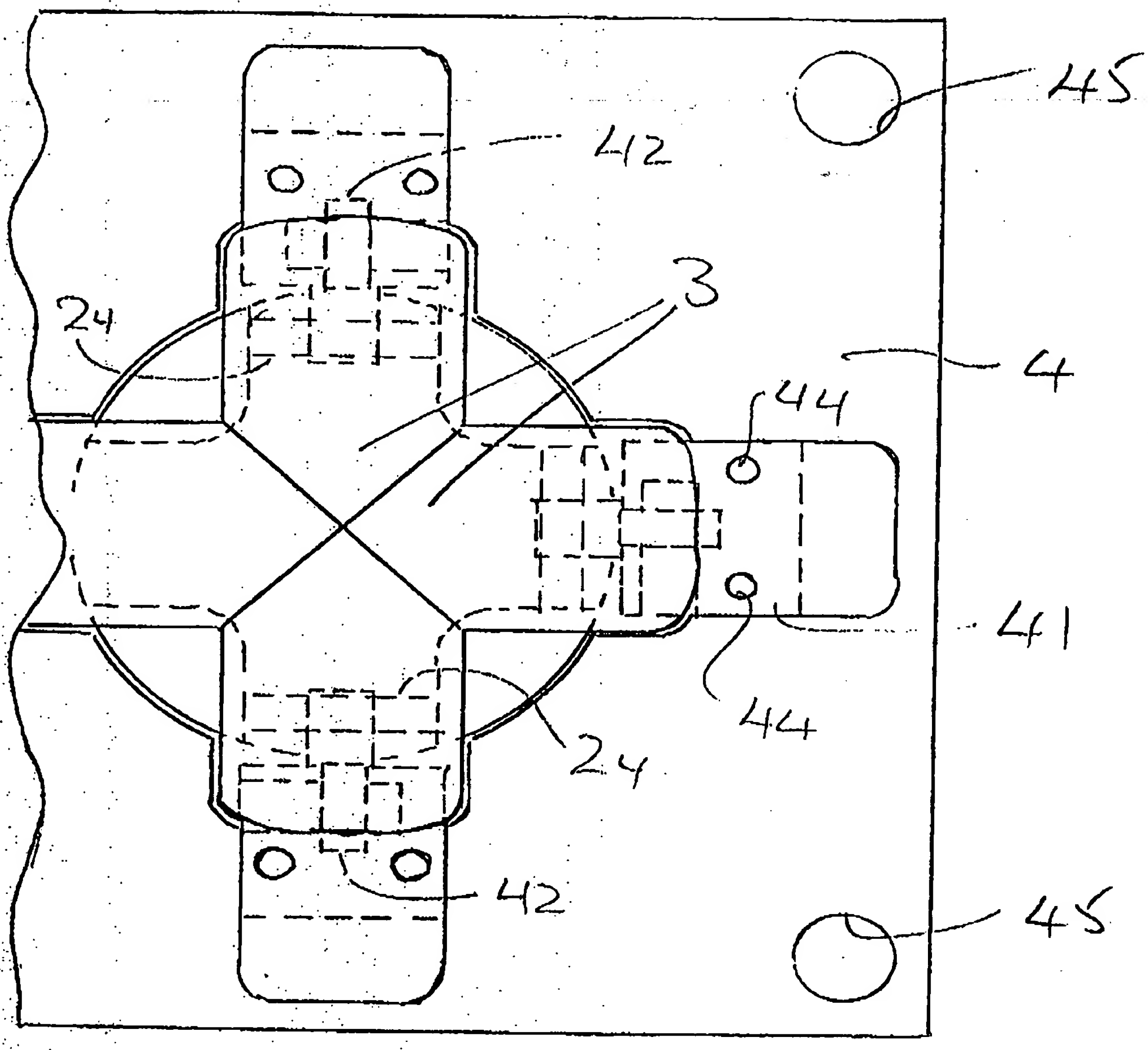

FIGURE 3

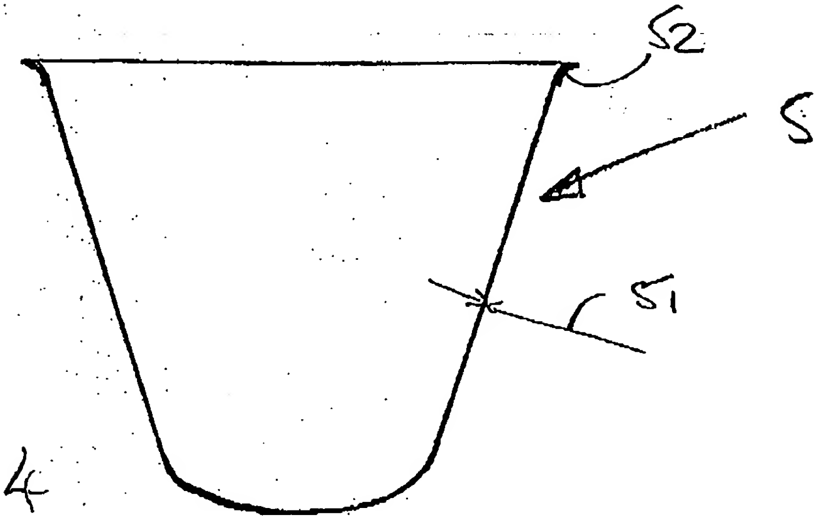

FIGURE 4

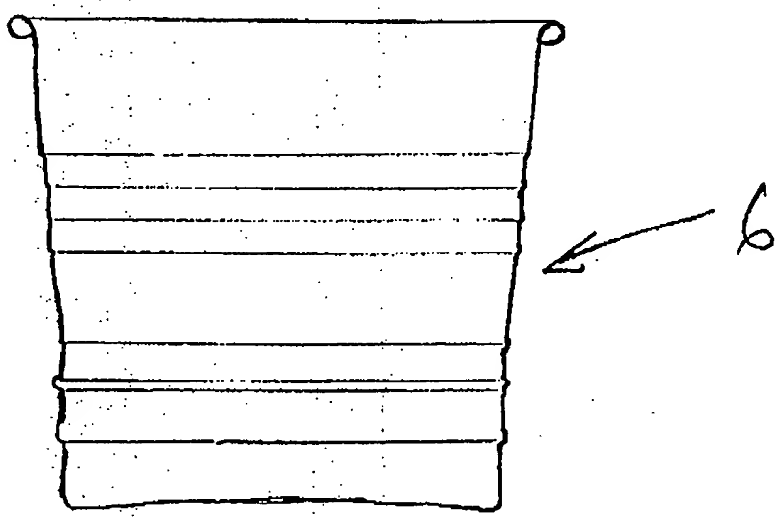

FIGURE 5

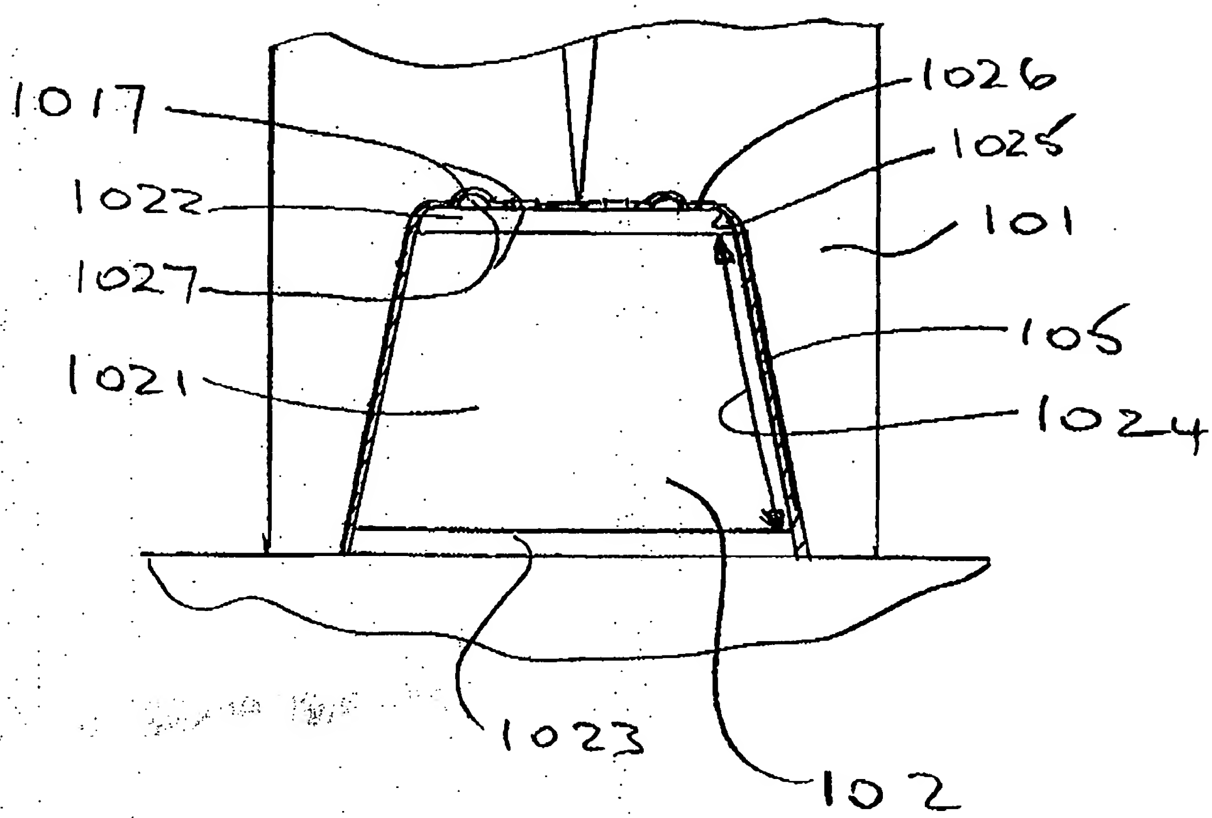

FIGURE 5

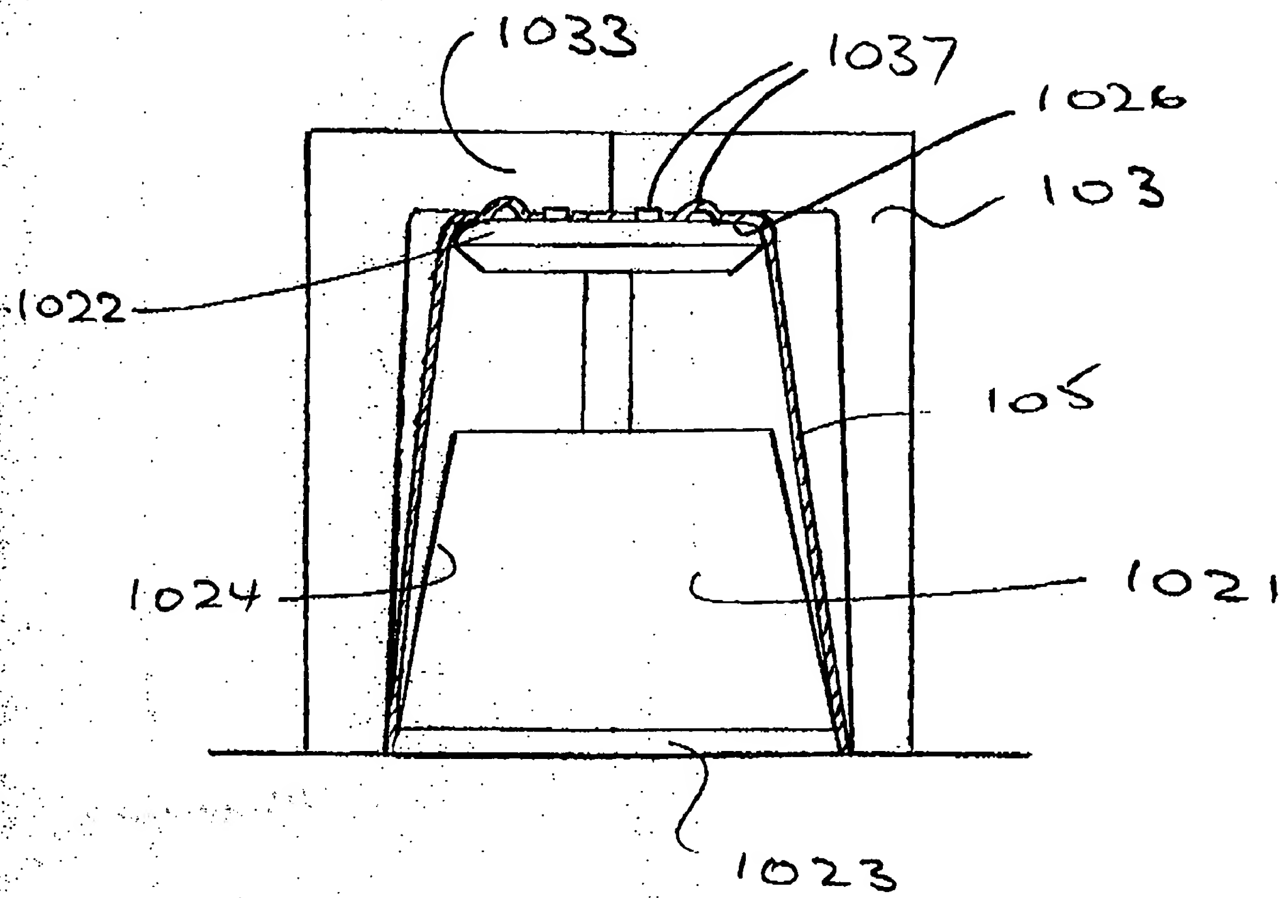

FIGURE 6

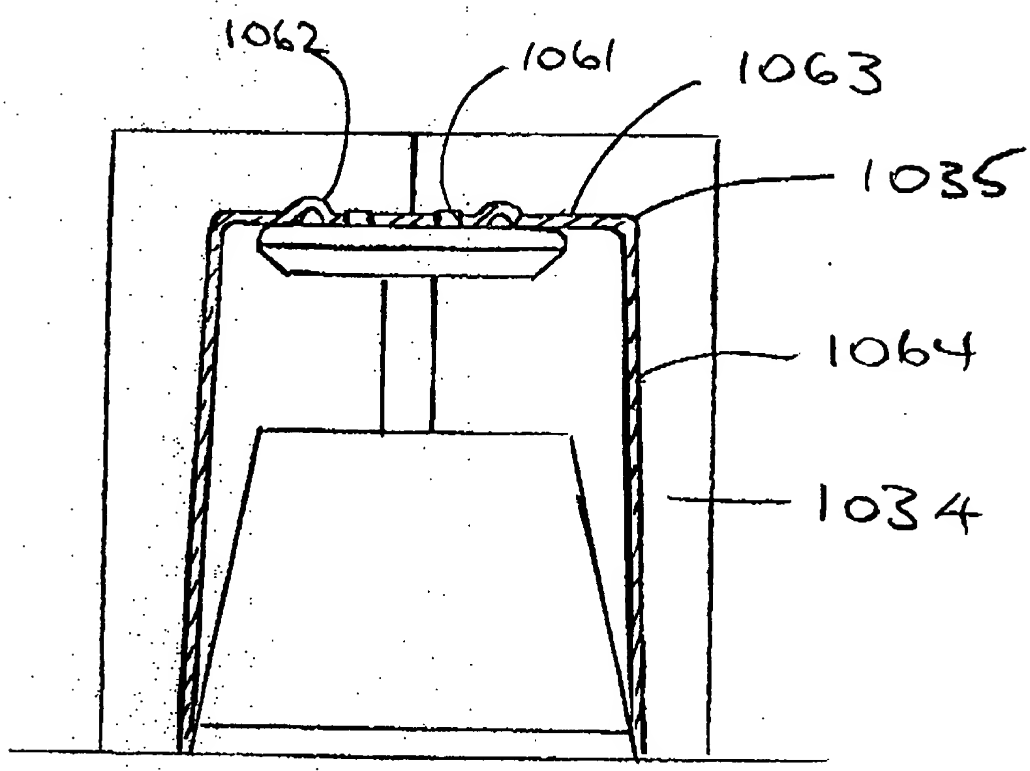

FIGURE 7

PCT/GB 98/ 03797

22/12/98

NIGEL BROOKS